EPA will support the State Water Board in ensuring that water quality standards to protect estuarine habitat are adequate, scientifically sound and integrated with related planning and regulatory efforts.

1. **EPA will support the State Water Board in establishing a year-round (12-month) estuarine standard in the revised Water Quality Control Plan for the Delta.**

Resident estuarine fishes require adequate estuarine habitat year-round. The1994 EPA and SWRCB standards to protect estuarine habitat only addressed February through June, because this period had been most affected by project operations and was the most sensitive period in the life histories of many fishes. Since the year 2000, habitat in fall months (September-November) has been affected more by project operations than in previous years. In their reasonable and prudent alternative under ESA to protect delta smelt (which is a species found with great consistency in the low salinity zone) USFWS required limited re-establishment of this estuarine habitat in some years. The USFWS requirement has generated much controversy and made more difficult the long-term planning effort for the estuary. Under CWA, SWRCB and EPA will work to define *suitable habitat in all seasons to protect all beneficial uses*, and identify acceptable *reference conditions* that correspond with sustainable populations of native aquatic species[1]. Comprehensive habitat protection will both safeguard the resident community and allow confident long-term planning for all beneficial uses.

Standards to protect estuarine habitat in the months from February through June were designed to retain a higher level of variability than would be required for protection in the consistently drier parts of the year (July-October). Protection in the "first-flush" season (November-January) needs to address both water quality impacts and migration of sensitive species that are tied to less predictable, but easily monitored patterns in precipitation.

2. **EPA will support the SWRCB in developing estuarine habitat standards for the revised Water Quality Control Plan that are explicitly related to ecosystem processes and adaptable to likely changes in the estuary.**

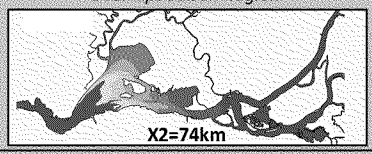
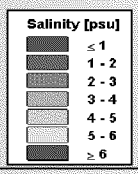
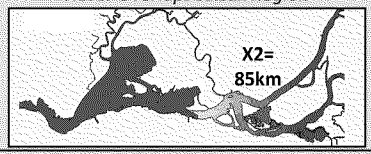
Understanding of the estuarine ecosystem has progressed tremendously since estuarine standards were first adopted in 1995 and standards in 2012 can be much more detailed and specific. New computer models portray flow effects on the extent and location of all salinity ranges. Thus, new standards, whether in terms of outflow, X2, or areal extent and location of the low salinity zone can better reflect habitat requirements of all species that use estuarine habitat. In addition we have 20 years of studies on how changes in salinity affect various parts of the ecosystem. By tying standards to ecosystem processes

and the physiology of some target species, the efficacy of regulatory action can be evaluated continually by appropriate performance measures. In addition, since new models can now predict the effects of changes in channel geometry, standards can more readily adapt to changing conditions.

3. **EPA will work with the SWRCB to integrate their revised estuarine habitat standards with control of other stressors to the aquatic ecosystem through the use of explicit performance measures.**

Delta outflow and its resulting salinity effects interact with many stressors to affect the estuarine ecosystem. For instance, stabilization of salinity regimes and the minimization of the areal extent of the low salinity zone for summer and fall in all years since 2000, has been tied to the emerging dominance of strictly freshwater species in much of the delta (such as *Egeria densa, Microcystis aeruginosa* and *Corbicula fluminea*) and the dominance of more marine species in much of Suisun Bay (particularly several introduced species of jellyfish and the overbite clam *Corbula amurensis)*. These introduced species have had direct effects on the pelagic estuarine ecosystem through predation, competition, toxicity and habitat alteration. This shift from estuarine species to invasive species amplifies the impact of other stressors. For example high abundance of Corbula allows greater uptake of selenium into the foodweb and Microcystis blooms are able to use ammonium from sewage outfalls that slow the growth of the diatoms that previously dominated. Habitat restoration and contaminant controls must be tied to performance measures so that regulatory efforts can be both effective and efficient.

Integrated modeling of physical conditions with changes in habitat, biological responses and effects of diverse stressors allows an integrated and responsive approach to water quality standards. Scientific work on the estuarine habitat has been guided by a series of conceptual models, which in turn have been modified as new information is incorporated (Baxter et al. 2010). The most recent model (below) clearly links the spatial distribution of low salinity habitat to a variety of stressors and ecological processes (BOR 2011). Such a model can simultaneously guide both regulatory and restoration actions.

Suisun Region	**Stationary Abiotic Habitat Components**	*River Confluence*
Higher	Bathymetric Complexity	*Lower*
Higher	Erodible Sediment Supply	*Lower*
Many in South, Fewer in North	Contaminant Sources	*Many*
Fewer	Entrainment Sites	*More*
Variable Fall Outflow Regime	**Dynamic Abiotic Habitat Components**	***Static Fall Outflow Regime***
Higher After Wet Springs	Net Total Delta Fall Outflow	*Always Low*
Higher After Wet Springs	San Joaquin River Contribution to Fall Outflow	*Always Low*
After Wet Springs, Broad Fall LSZ Overlaps Suisun Region 	Location and Extent of the Fall LSZ (1-6 psu) 	*Narrow Fall LSZ In River Channels, Never Overlaps Suisun Region* 
Higher After Wet Springs	Hydrodynamic Complexity in the Fall LSZ	*Always Lower*
Higher After Wet Springs	Wind speed in the Fall LSZ	*Always Lower*
More Variable, Higher After Wet Springs	Turbidity in the Fall LSZ	*Always Less Variable, Lower*
More Variable, Maybe Lower After Wet Springs	Contaminant Concentrations in the Fall LSZ	*Less Variable, Maybe Higher*
LSZ Overlaps Suisun Region	**Dynamic Biotic Habitat Components**	***LSZ Overlaps River Confluence***
Higher	Food Availability and Quality	*Lower*
Variable	Predator Abundance	*Higher*
LSZ Overlaps Suisun Region	**Delta Smelt Responses**	***LSZ Overlaps River Confluence***
Broad, Westward	Distribution	*Constricted, Eastward*
Higher	Growth, Survival, Fecundity	*Lower*
Better	Health and Condition	*Worse*
May be Higher	Recruitment in the next Spring	*Lower*

The estuarine ecosystem needs urgent protection but some stressors will take longer to address than others. Immediate actions to protect aquatic resources are needed to ensure that the estuarine ecosystem is present to receive the benefits of long-term investments. For example, the Bay Delta Conservation Plan proposes a plethora of actions to restore habitat and ecosystem processes in the delta but most will not be implemented for many years; as habitats in the delta are restored and stressors are reduced, the location and extent of habitats in Suisun Bay will likely to change in importance. Similarly, impacts of ammonium loads will be reduced in the Sacramento River as improvements are made to treatment facilities. A time-line of all such anticipated changes and their expected impacts on performance measures (as suggested by the figure above) will allow prompt reconsideration of the regulations needed to protect estuarine habitat.